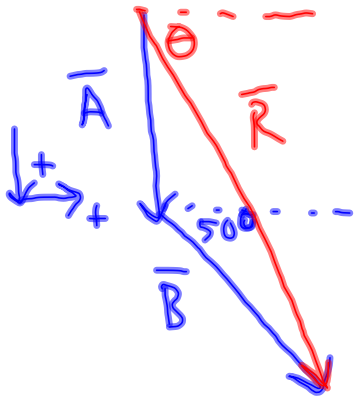
River Problems:

- Vector problem because boat and current both have velocity
- We can find net velocity, displacement, and time

As a boat travels 3.33 m/s due south, there is a current pushing 2.22 m/s at 50 degrees south of east. What is the resultant speed and direction of the boat?



$A_x = (3.33\ m/s)\cos(90°) = 0$

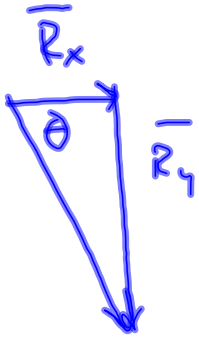
$+\ B_x = (2.22\ m/s)\cos(50°) =$

$R_x = 1.43\ m/s$

$A_y = 3.33\ m/s$

$+\ B_y = (2.22\ m/s)\sin(50°)$

$R_y = 5.03\ m/s$



$R^2 = R_x^2 + R_y^2$

$R = 5.23\ m/s$

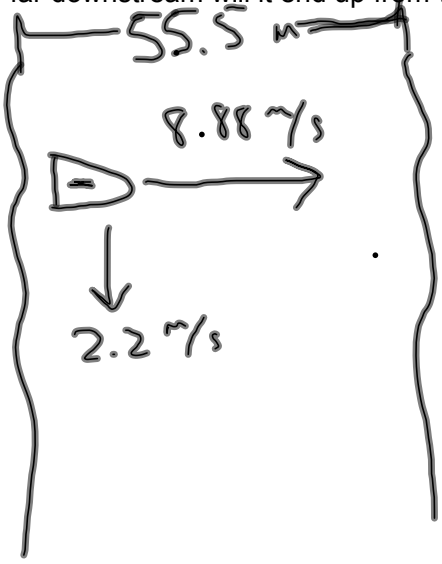
$\tan\theta = \frac{R_y}{R_x}$

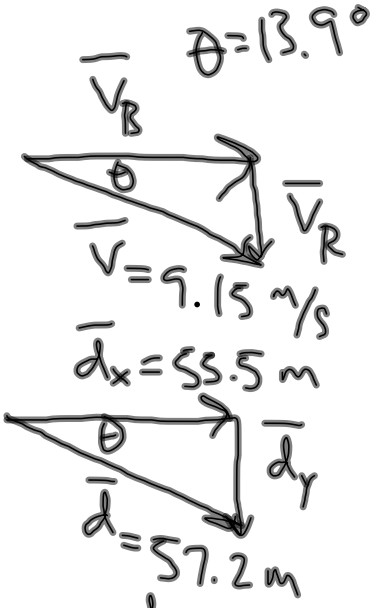
$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$

$= 74.2°$

$\overline{R} = 5.23\ m/s\ @\ 74.2°$ South of East

A boat travels due east at 8.88 m/s. There is also a 2.2 m/s current south acting on the boat. The river is 55.5 m wide.
a) How long will it take the boat to cross the river?
b) How far downstream will it end up from where it started?





$\cos\theta = \frac{d_x}{d}$

$d = \frac{d_x}{\cos\theta}$

a) $V_B = \frac{d_x}{t}$

$t = \frac{d_x}{V_B}$

$= \frac{55.5\ m}{8.88\ m/s}$

$= 6.25\ s$

b) $V_R = \frac{d_y}{t}$

$d_y = V_R t$

$= (2.2\ m/s)(6.25\ s)$

$= 13.75\ m$

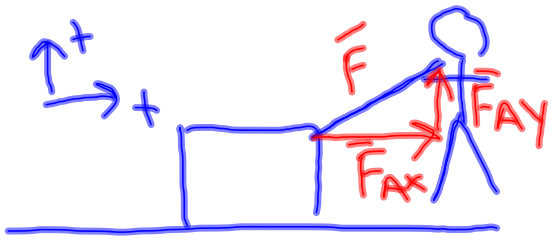
θ = 13.9°

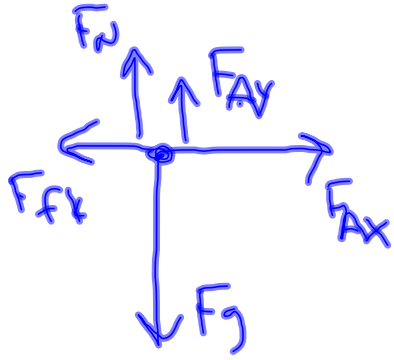
$\tan\theta = \frac{d_y}{d_x}$

$d_y = d_x \tan\theta$

$= 13.75\ m$

A 2.5 kg crate is pulled by a rope with 30.0 N at 36 degrees above the horizontal, and the coefficient of friction between the crate and floor is 0.222. What will be the acceleration of the crate?





$$\Sigma \bar{F}_x = m\bar{a}_x$$

$$a_x = \frac{\Sigma F}{m}$$

$$= \frac{F_{Ax} - F_{fk}}{m}$$

$$= \frac{F_A \cos(36°) - \mu_k (F_g - F_{AY})}{m}$$

$$= \frac{F_A \cos(36°) - \mu_k m a_g + \mu_k F_A \sin(36°)}{m}$$

$$= 9.12 \text{ m/s}^2$$

$$F_{fk} = \mu_k F_N$$

$$= \mu_k (F_g - F_{AY})$$

$$\Sigma \bar{F}_y = 0$$

$$F_N + F_{AY} - F_g = 0$$

$$F_N = F_g - F_{AY}$$

$$F_g = m a_g$$

$$F_{AY} = F_A \sin(36°)$$